

The cover member 404 includes four circular openings with upwardly-turned peripheral flanges 401 through which shafts 423 extend. Upward flanges 401 can advantageously prevent spilled liquids from flowing into the openings.

The container holders 406 comprise generally cylindrical members having an open bottom and an open top for receiving and holding a container 440, preferably a plastic bottle, of target capture reagent.

The target capture reagent used with the preferred assay includes magnetically responsive particles with immobilized polynucleotides, polynucleotide capture probes, and reagents sufficient to lyse cells containing the targeted nucleic acids. After cell lysis, targeted nucleic acids are available for hybridization under a first set of predetermined hybridization conditions with one or more capture probes, with each capture probe having a nucleotide base sequence region which is capable of hybridizing to a nucleotide base sequence region contained on at least one of the targeted nucleic acids. Under a second set of predetermined hybridization conditions, a homopolymer tail (e.g., oligo(dT)) of the immobilized polynucleotides is capable of hybridizing with a complementary homopolymer tail (e.g., oligo(dA)) contained on the capture probe, thereby immobilizing targeted nucleic acids. Target-capture methods and lysing procedures are well known in the art and are described more fully in the background section *supra*.

A container retainer spring 408 spans a lateral slot formed in the wall of each container holder 406 and helps to hold the container 440 within the container holder 406 by urging the container 440 toward a portion of the inner peripheral wall of the holder 406 opposite the spring 408.

Each container holder 406 is secured to an associated vertical shaft 423 by a shaft block structure 432. Shaft block structure 432 includes curved end portions which conform to the inside of the cylindrical container holder 406, and the container holder 406 is secured to the block 432 by fasteners 434. A generally circular aperture 449 receives the shaft 423. A slot 438 extends from aperture 449 to an end of the block 432 which does not extend all the way to the inside of the container holder 406, and a second slot 436 extends from an edge of the block 432 generally perpendicularly to slot 438 so as to define a cantilevered arm 435. A machine screw 437 extends through a through-hole 441 formed laterally through block 432 and into a threaded hole 447 formed laterally through arm 435. As screw 437 is tightened, arm 435 deflects, thus tightening aperture 449 around shaft 423.

The shaft block structure 432, the shaft 423, and the container holder bearings 415 associated with each container holder 406 define a preferred container holder mounting structure associated with each container holder 406 that is constructed and arranged to mount the container holder 406 to the turntable 414 and permit the container holder 406 to rotate about an axis of rotation 412 of the shaft 423.

Container holder planetary gears 422 are attached to the opposite ends of shafts 423. The planetary gears 422 operatively engage a stationary sun gear 416. A drive pulley 418 is attached to center shaft 428 and is coupled to a drive motor 420 by a drive belt (not shown). Drive motor 420 is preferably mounted so as to extend through an opening (not shown) in the jig plate 130 below the base 402. Drive motor 420 is preferably a stepper motor, and most preferably a VEXTA stepper motor, model number PK264-01A, available from Oriental Motor Co., Ltd. of Tokyo, Japan. The drive motor 420, via the drive belt and drive pulley 418, rotates the center shaft 428 and the turntable 414 attached thereto. As the turntable frame 414 rotates about the center line of center shaft 428, the planetary gears 422 engaged with sun gear 416 cause the shafts 423 and container holders 406 attached thereto to rotate at the ends of the arms 444 of the turntable frame 414. Each container holder 406 is preferably mounted such that the axis of rotation 410 thereof is offset from the axis of rotation 412 of the associated shaft 423. Thus, each container holder 406 rotates eccentrically about axis 412 of the associated shaft 423. Accordingly, the planetary gears 422 and the sun gear 416 constitute rotational motion coupling elements constructed and arranged to cause the container holders 406 to rotate about the respective axes of rotation of the shafts 423 as the turntable 414 rotates about the axis of rotation of the shaft 428.

A bar code scanner device 405 is preferably mounted on a bracket 403 and reads bar code information of the containers 440 through a scanner slot 407 formed in each container holder 406. The preferred scanner is a model number NFT1125/002RL scanner, available from Opticon, Inc. of Orangeburg, New York.

The multi-axis mixer 400 usually rotates during operation of the analyzer 50 to agitate the fluid contents of the containers 440 to thereby keep the target capture reagent in suspension, stopping only briefly to permit pipette unit 456 to withdraw an amount of mixture from one of the containers. Pipette unit 456 draws mixture from a bottle at the same location each time. Therefore, it is desirable to monitor the positions of the bottles so that the bottle from which mixture is withdrawn each time can be specified.

Four optical slotted sensors 426, each comprising an optical emitter and detector, are stationed around the periphery of fixed base 402, spaced at 90° intervals. Optical sensors available from Optek Technology, Inc. of Carrollton, Texas, model number OPB490P11, are preferred. A sensor tab 424 extends down from extension 417 at the end of arm 445 of the turntable 414. When sensor tab 424 passes through a sensor 426, the communication between the emitter and detector is broken thus giving a "container present" signal. The tab 424 is only provided at one location, e.g., the first container location. By knowing the position of the first container, the positions of the remaining containers, which are fixed relative to the first container, are also known.

Power and control signals are provided to the multi-axis mixer 400 via a power and data connector. While the multi-axis mixer 400 provides mixing by rotation and eccentric revolution, other mixing techniques, such as vibration, inversion, etc. may be used.

SPECIMEN PREPARATION PROCEDURE

To begin specimen preparation, the pipette unit 456 moves to transfer target capture reagent, preferably mag-oligo reagent, from a container 440 carried on the multi-axis mixer 400 into each of the receptacle vessels 162 of the MTU 160. The target capture reagent includes a support material able to bind to and immobilize a target analyte. The support material preferably comprises magnetically responsive particles. At the beginning of the specimen preparation procedure, the pipette unit 456 of the right-side pipette assembly 450 moves laterally and longitudinally to a position in which the probe 457 is operatively positioned over a pipette tip in one of the trays 372.

The tip trays 372 are carried on the pipette tip wheel 350 so as to be precisely positioned to achieve proper registration between the pipette tips and the tubular probe 457 of the pipette unit 456. The pipette unit 456 moves down to insert the free end of the tubular probe 457 into the open end of a pipette tip and frictionally engage the pipette tip. The Cavro processors preferably used for pipette unit 456 includes a collar (not shown), which is unique to Cavro processors. This collar is moved slightly upwardly when a pipette tip is frictionally engaged onto the end of the tubular probe 457, and the displaced collar trips an electrical switch on the pipette unit 456 to verify that a pipette tip is present. If tip pick-up is not successful (e.g., due to missing tips in the trays 372 or a misalignment), a missing tip signal is generated and the pipette unit 456 can move to re-try tip engagement at a different tip location.